Applied and Environmental Microbiology 2015 vol.81 N19, pages 6790-6799

Novel glucose-1-phosphatase with high phytase activity and unusual metal ion activation from soil bacterium Pantoea sp. strain 3.5.1

Suleimanova A., Beinhauer A., Valeeva L., Chastukhina I., Balaban N., Shakirov E., Greiner R., Sharipova M.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2015, American Society for Microbiology. Phosphorus is an important macronutrient, but its availability in soil is limited. Many soil microorganisms improve the bioavailability of phosphate by releasing it from various organic compounds, including phytate. To investigate the diversity of phytate-hydrolyzing bacteria in soil, we sampled soils of various ecological habitats, including forest, private homesteads, large agricultural complexes, and urban landscapes. Bacterial isolate Pantoea sp. strain 3.5.1 with the highest level of phytase activity was isolated from forest soil and investigated further. The Pantoea sp. 3.5.1 agpP gene encoding a novel glucose---phosphatase with high phytase activity was identified, and the corresponding protein was purified to apparent homogeneity, sequenced by mass spectroscopy, and biochemically characterized. The AgpP enzyme exhibits maximum activity and stability at pH 4.5 and at 37°C. The enzyme belongs to a group of histidine acid phosphatases and has the lowest Km values toward phytate, glucose-6- phosphate, and glucose-1-phosphate. Unexpectedly, stimulation of enzymatic activity by several divalent metal ions was observed for the AgpP enzyme. High-performance liquid chromatography (HPLC) and high-performance ion chromatography (HPIC) analyses of phytate hydrolysis products identify DL-myo-inositol 1,2,4,5,6-pentakisphosphate as the final product of the reaction, indicating that the Pantoea sp. AgpP glucose-1-phosphatase can be classified as a 3-phytase. The identification of the Pantoea sp. AgpP phytase and its unusual regulation by metal ions highlight the remarkable diversity of phosphorus metabolism regulation in soil bacteria. Furthermore, our data indicate that natural forest soils harbor rich reservoirs of novel phytate-hydrolyzing enzymes with unique biochemical features.

http://dx.doi.org/10.1128/AEM.01384-15